Oct 27th, 2:00 PM - 5:00 PM

Technical Workshop - The Nation's Space and Scientific Programs

Canaveral Council of Technical Societies

Moderator - Dr. D. B. Duncan, Asst. Gen. Mgr., Aeronutronics Div., Ford Motor Co., Newport Beach, California

Panelists - Lt. Col. Melvin D. Clark, USA, Chief, Atlantic Missile Range Army Field Office and Dir. Army Tests, AFMTC, Florida

Col. Robert R. Hull, USAF, Chief, Thor/Gemini Launch Vehicle Div., 6555th Aerospace Test Wing, AFMTC, Florida

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THE NATION'S SPACE & SCIENTIFIC PROGRAMS - WORKSHOP

After introductory remarks by the moderator, the meeting was opened with comments by Col.Clark: Rather than attempt to delineate specific problems, I was going to approach it by first giving the mission of the Army and secondly, what the Army's position is as far as space is concerned, and then render a little philosophy along those lines.

The mission of the Army was recently expressed by General Decker in the October, 1962 issue of Army, 'The basic and overriding mission of the Army is to conduct successful, sustained combat operations in the land environment." This, in itself, is a simple statement of a fairly large problem. So far as space is concerned, the Army views it as a largely unknown medium.

I feel for my own part that we are facing basically two problem areas. The first of these is that of conception. This is the area that can be given a proper framework by such adjectives as inventive, imaginative, the breakthrough, research, the search for talent. This is the problem of conception. The second problem area is that of utilization or application. To this area I attach such adjectives as pragmatic, the problem of decision - what choice to make, the problem of recognition - what sources of knowledge you have - which are those to be used. It's a problem of development as opposed to research and, in this area of utilization, it's a problem of skill as opposed to the talent and the concept. So to me, these are the two fundamental things; the problem of conception and the problem of utilization. Whether they're applicable to the Army, the Air Force, NASA, the Navy, or to industry, they will still remain the basic problems.

Col. Hull: (Not speaking for the U.S. Air Force but as a member of the U. S. Air Force.) I would like to address my comments to some of the overall problems we have seen as a result of testing in the past, and some of the problems we can foresee in going into the future.

If we look back in history when the Germans first started testing the V-2 rocket, we have a fairly graphic illustration of the lack of technical knowledge at that time. It took the Germans 3,000 test flights before they had their first successful missile. That was about twenty-five years ago. In turn, we started the testing of ballistic missiles some seven or eight years ago and, the Atlas being among the first, we had to do it by steps. First we tested the propulsion system and later added the guidance system and so on until it had taken us approximately five to six years before we were able to test the operational concept of the Atlas Weapon System.

Recently, both the Army and the Air Force have demonstrated how this technical knowledge has accumulated. Both the Minuteman and Pershing were tested as fairly complete systems on their first test flights. We do, however, need additional testing beyond this; one successful flight with a mission

is not enough. We must go on and do repeated testing in order to achieve an operational capability. We must have a weapon in being that will stay in operational condition for a long period of time, has a very fast reaction time and can be launched by people who are not scientists.

From this we have stepped into the space age, and I would say that at the present time we are only on the brink of the space age. Our space exploration today is done with the boosters that were developed by the military weapons systems.

Because of the limited thrust available we have made tremendous strides in other areas. This includes the miniaturization of components, and increasing the reliability of these miniaturized components. In doing this we are gaining strides on anyone who has more thrust or propulsive power available to them. I believe we are getting as much information back from outer space with our 300 and 400 lb satellites as Russia is with their 2,000 and 3,000 lb satellites.

I think the biggest problem in going beyond the stage we're in at the present time is the tremendous size of the vehicles required to put the spacecraft not into orbit, but into manned space travel. I fully believe that with the existing devices that we have - vehicles that are developed and the ones that are under development - we will be able to do the near earth travel, the lunar orbits, the lunar landings without any great break-throughs in technology. Anything beyond that, I believe, will take some tremendous break-throughs.

Mr. Tamm: I was asked to discuss the legal challenge in the race to space. To me, it seems the space race on both sides is going quite well without the aid of the lawyers. However, this cannot exist for long and I would suggest to you that the basic question that the legal profession has at this time is, "Should the law of space precede space activity or should it follow?"

A couple of years ago, most legal scholars felt that the race to space was so far off that it really wasn't of great concern. However, there was a small minority, which has grown to the majority, who now feel the time has come when the legal profession must catch up with this race and must set up its own program. Most lawyers feel it is now necessary to regulate space activity. Of course, as of today, there is no real binding authority that can direct or restrict the activities of space.

The important question is, "Is international law, as it now exists, adequate for use in space?" Obviously it is not. The existing principles, developed through custom and agreement, have resulted from the activities on land, at sea and in the atmosphere. They have not resulted from activities beyond.

What are these new problems that have been generated by our space activity? The major question, which has been sidestepped for some time, is - Where do the nations' sovereignties end? How far distant from earth does this free space begin? Equally as thorny a problem is - How do we protect individuals on the ground from injury? In what legal form should we seek redress? How would we clear space of all this rubble they're going to put

up which will be not useful to us in a short period of time? What will be the status of the space stations they're going to be launching from the Cape in the not-too-distant future? Who will prevent, who will punish an individual or a nation who chooses to tap the space phone circuits of the Telstar satellites?

Perhaps we're not sufficiently informed to develop a complete and comprohensive set of rules or laws, but in and of itself space must be free of restraint upon its use. Certainly we must develop principles to govern the peaceful use of space, and to this extent it is important the basic ground rules be established.

I would suggest to you, and to my profession, that it is time the legal profession retire to the laboratory, develop a basic working document for guidance in space, and build, in union with the space architects, the law of space.

Dr. Duncan: It occurred to me that there is an interesting situation with respect to the interaction between the space program and the scientific programs. There are many reasons that one can think of for going into space. I think it's very remarkable that such a relatively large percentage of our space programs can be justified on a purely practical basis. Telstar, the communications satellite, is a program which makes sense. It makes sense not because it's exotic, not because there's research involved, not because of national prestige. It makes sense because it's cheaper to get communication from one continent to another via satellite than any other method we know. Communications satellites, therefore, represent a reason for going into space solely for dollars and cents.

There are certain things that can be done in the military sense better in space than can be done anyplace else. And the justification for such programs can be based solely on the fact that these programs make sense. When you get up into space you can see further than you can from anyplace else. If it's important for you to be able to see long distances, then you better get up in space.

There is a second, or underlying reason, for going into space that we all recognize. Namely, the quest for national prestige. We know that we're in a race with the Russians. To a number of people, the relative success of our economic system versus that of the Soviet Union will be determined by our relative ability to put objects into orbit. Yet, I'm sure you can show that if these were the sole reasons for space exploration programs, they would not be justified.

There are other programs which can only be described as research. The target is there and the basic instincts of the human race are that when something can be done - it must be done. As a technique for starting the discussion we might return to the keynote address which Dr. Golovin made this morning. I might very briefly summarize his points. They were that there will be an active period of space exploration until roughly 1970, with the basic objective of getting a man on the moon. There will then follow a period of 15 to 25 years with the objective of carrying out manned exploration of the solar system. After that the activities of this time period will tend to level off. I think Dr. Golovin tended to throw a little

cold water on what happens after that point with respect to exploration beyond the solar system into the galaxy. He gave some very graphic illustrations of the power which would be required for getting a man from here to any of the nearby stars. He implied that we can expect a gradual tailing off of the activities in the space program and that the talents and resources of the country by that time probably would be concentrating on some other aspect of research and exploration.

I'd like to make my own comments on Dr. Golovin's statements and then see if we can get someone here who either agrees or disagrees with me. I think his description of what will happen in the first ten years is very reasonable and very accurate. I also think his description of what will happen after that time was quite reasonable. Probably most of us have spent very little time in thinking about what happens beyond that.

I think it is clear that there cannot be exploration beyond the solar system within the scientific framework as we know it at the present time. I also think it would be a mistake to assume that within the next 30 to 40, or 100 to 200 years, there will not be changes as fundamental as those that have occurred since 1500, which will make manned exploration beyond the solar system feasible.

Col. Hull: In the past, we have been living within certain limitations. We have limitations that we recognize as physical laws which would limit our ability to do anything better. For instance, we can't believe that anybody will ever achieve perpetual motion. On the other hand we have, just in our own life span, seen growth in the way man can propel himself. Looking back to about 1910, the Wright brothers could barely achieve 100 miles an hour. By 1960 we were doing 2400 miles an hour, and recently some of the astronauts have travelled about 17,500 miles an hour. The speed with which we're able to travel in interplanetary spaces must be increased if we can reasonably get there in a man's lifetime and return.

Speaking of technical limitations, in aircraft we have overcome the speed of sound and the heat barrier. Now the physical barrier on this approach is the speed of light. I don't believe anybody here can envision just how anybody is going to achieve this kind of speed for interplanetary travel.

I'd like also to pose the idea that even though we accept the speed of light at the present time as an absolute physical barrier, in the future we might find that it is not the final physical barrier for travel. I do believe that we must keep an open mind - we must not accept these limitations as we now know them.

Dr. Duncan: I think we might return to Mr. Tamm's question. How are the laws of space going to be enforced? Here we open up a new area in which laws do not exist. The fundamental element of it is that it isn't a law unless it's enforceable, and where do we go from this point?

Col. Clark: I'll comment on it. I feel like you, that if we have the normal acceptance of the concept of law that we inherently have the normal acceptance of enforcement. There is one element, however, that has been explored historically and that is mutual cooperation. This involves some aspects of national prestige and whether or not sovereignty will continue as

such. A good example of this has been cooperation in exploration of the Antarctic. A number of nations cooperated to provide mutual interchange of information during the National Geophysical Year. A similar type of cooperation is involved in such international organizations as the United Nations.

One of the old laws basic to the extent of space, goes back to the early days of Holland. They were attempting to determine how far from shore their limits should be. Out of this developed the concept that you could go as far as you could protect. I suspect that under the present circumstances this sort of philosophy will break down rather quickly because the universe is a rather large area. If this happens to be a true analysis, then we can look forward to even greater international cooperation in extending research into space for our mutual good.

Dr. Duncan: I suspect it will be relatively easy to get international cooperation with respect to probes that might go out and measure the ionization level in space in certain periods. But I expect we're going to have difficulty in getting international cooperation with respect to reconnaissance satellites which are supposed to find out what the enemy has in the way of ICBM launch bases. The extent of the willingness of the nations to cooperate gets into how vital they consider it is with respect to national security.

Mr. Tamm: I have to agree with Col. Clark that this is only going to be solved by a treaty or an agreement such as you have on Antarctica.

With respect to the difference between one type of satellite and another I would call to your attention the fact that we have this problem with aircraft. The U-2 incident brought this to the forefront. The only distinction I think we could make is the U-2 was operating within the atmospheric levels beyond earth - perhaps near, perhaps very far from what we may determine is free space.

There probably will have to be some controls leveled at the launch site, some means to determine what type of vehicle is being launched. Tiros, for example, can do surveillance as well as obtain meteorological information. So we've got a vehicle with a peaceful purpose which can also perform military surveillance.

Dr. Duncan: Somehow or other you've got to draw up the agreement that describes what you can and can't do and then a method of enforcement.

Mr. Tamm: A method of enforcement is the strong and hard part.

(Questions from the floor brought out the following additional comments from the panel.)

Dr. Duncan: There is undoubtedly a limit which would exist on the dollars which could be spent on a space program. We already know that the nation is able to support a defense program which has a dollar volume very much greater than the space program that we're talking about. If, for example, we were to come to some form of reasonable and enforceable agreement with the Soviet Union concerning disarmament, there could be massive rear-

rangements of the national budget that would permit large numbers of dollars to go into the space program without any effect on the total national budget. Even within the framework of continuing the defense expenditure, the space effort is a significant but relatively small percentage of the national budget.

Col. Hull: If you take the old equation that force is equal to the mass times acceleration, I think work should proceed in the area of extremely high acceleration to small masses. Microminiaturization of components gives us less mass yet has extremely high reliability. We can't miniaturize people and we can't miniaturize their needs for food and oxygen so we have to miniaturize what they use to maintain themselves on their journey. Where one system and only one system can be carried it will have to be a reliable system. We can't afford to have any redundancy just for safety's sake. I don't think anybody can miniaturize a machine that can observe and record what he sees the way a man can, therefore we're going to do manned space travel. Now, if we want to do just space travel or strict technical research and data gathering, then we might have an adaptive device - a "man simulator" - that can give us 25 or 30 percent of what a man could in space travel.

Dr. Duncan: We all know that with instruments we can be more efficient as far as measuring some particular things. If we want to measure temperature, it's a lot easier to put a thermometer out there than it is to put a man and let him try and feel how hot or cold it is. If we want to carry out a particular computation, we can do it much faster with a digital computer than we can with a man. I think the development of adaptive machines is a very important and very vital thing - learning how to come up with systems which can come closer to doing what the human being can do. The problem is really with the state of the art at the present time.

Question: A great amount has been said today about the utilization of scientific brainpower. If there is a need, is there also some means of locating it and channeling it to places where it's needed?

Col. Hull: Recently, the Air Force has done something on this order. They have identified every technical person in the Air Force associated with either the missile or the space testing field. They have identified them as to what jobs they have held, what their experience has been, the level of technical ability or education they have and have catalogued them in this way. The assignment of these people is controlled from one assignment office.

Question: Do you think that there will be eventually some sort of a national system - a big fat employment service - that would keep track of people who had certain critical skills and assign them?

Dr. Duncan: My answer is "no." I don't think it should work that way. You have to get back into competitive bidding.

Mr. Tamm: Dr. Duncan, I'd like to make a few remarks. I'm afraid that if we were to go to a system like that just mentioned we would have something like that existing in Russia. Having a national employment service where a man has to go to work where he may not necessarily desire to work just because he has a natural capability is a Russian technique. I would

certainly hate to see the same procedure used here.

Dr. Duncan: There was a discussion this morning about the need for a university - called the Space Age University. This has been talked up mainly in this area.

Mr. Tamm: Any increase in learning and the productivity of higher learning is going to help our programs. From what I have read about educational facilities, they are always not enough and the more there are and the better they are, the more effective our programs will be.

Question: Do industry and the military services involved in this space program themselves conduct active post-graduate work - make it available to personnel - or do they rely on the local area to provide the facilities?

Col. Hull: I think most of the military recognize the fact that they must have people within the services who have advanced degrees and, of course, they're striving continually to have all their officers obtain at least a bachelor's degree. I know the Air Force at the present time is assigning between 2,000 and 3,000 of its officers every year into civilian universities to study and obtain masters and doctors degrees. They also have, at the present time, the Institute of Technology at Wright Patterson which gives both undergraduate and graduate degrees. They are recognizing the fact that they must keep on the level with the industrial complex in order to do the development they feel is necessary.

As far as establishing a university in this area, my personal opinion is that this population explosion we talk about and hear about has grown at the same exponential rate that technical knowledge has. If we keep this exponential growth of technical knowledge coming, we must have the technical people in ever increasing numbers to use it and apply it. Yes, we need more universities and need to do basic research and to teach people.

Dr. Duncan: If you look at the prime concentrations at the moment, the electronics and technical industry, they are roughly grouped around MIT and CAL Tech. I think the basic reason for industry going there in the first place was the location of the universities. A current look at the industrial map does show that a strong, capable institution will attract this kind of industry. My advice as an outsider is that any dollars you could expend in this area would be very, very well spent in the way of return.

Col. Clark: We in the Army are looking towards the fallout values that we can expect from space research. For example, communications, weather, geodetic type surveys, plus the other fallout values associated with space phenomena, associated with detection and killing of re-entry type bodies in the missiles. As to which is more important, the immediate area of space or some area beyond, I find it pretty hard to say because I feel sure in my own mind that we're not really adequately getting prepared to go beyond the first step.

Dr. Duncan: Basically, there are three methods of getting to the moon. There is direct ascent in which you just sort of go there, the earth

orbital technique in which you first orbit the earth and from there launch to the moon, and the lunar orbiting technique in which you orbit the moon and then launch. NASA's decided that lunar orbiting is the way to go. There are lots of people who don't agree with them. I don't claim to be an expert on it at all. However, I believe the most efficient method of getting something from here to the moon would be to first get in a stable orbit around the earth. We would send up relatively small things - we would assemble them there. Then, I think, we would go from that to a lunar orbit and we would go from a lunar orbit to send things down to the surface of the moon and assemble them there. Then we would proceed back, step by step. Now the things I have described require five different assemblies. It clearly is too complex. So the people who are trying to make these kinds of decisions are trying to decide what they will trade off in the way of directness versus complexity. The most direct way is to build the whole thing here on the earth, shoot it up to the moon and shoot it directly back. And that is the most inefficient way of doing it. The current concept of lunar rendezvous is less efficient than the concept of earth rendezvous. However, it is felt by the people making the study that looking at all the trade-offs involved, the lunar orbit offers a greater chance of success.

Question: Col. Hull, would you define a space system?

Col. Hull: I don't know whether I can define a space system but I'll try. Let's go back a few years in development. We used to develop an airplane. And after we found one that would fly, we'd try to find out what else we could do with it. We could hang cameras in it; it might be a bomber; we could make a tanker out of it; we could make an ECM (electric-counter-measures aircraft) out of it; and so we did not have to develop a system. Then the systems concept came along. In this we determined the objectives that we were going to develop a system to achieve. Not only do we develop a missile, but we develop the guidance system and propulsion system, the re-entry system, and we don't stop there. We also develop the ground environment system, the ground support equipment, the technical orders so that the military people can check it out and launch it, the environment in which it is stored in ready condition. This is a complete system development. If we have a space system this includes the complete development of what we will do on the other end. If we have a lunar landing, the environmental shelters for any people up there, and suits, the equipment to get back with. I would say a space system is a complete approach to a project.

Question: We are certain that we can go to the moon and certain nearby planets, but Dr. Philip Morrison has made some calculations that tend to agree that going to stars at this time is rather unreasonable to think about. He advocates attempting to receive the messages that he feels certain are being sent by other intelligences and making use of this information from possibly higher forms of life. Why aren't we doing more in this area?

Dr. Duncan: There is such a program going, as you know. I think it would be very interesting to see if anything is uncovered. If you want to speculate on something you can raise the question of what do we do if we do get some signals. I remember reading an interesting article by Al Gibbs,

who is a good friend of mine. He is the science director at JPL. His immediate suggestion was that if we do receive messages from outer space, that we stop and pay no more attention to it. Because all indications are that if there is a higher form of life up there that finds our we're here - we may end up being the cattle in the great grand galaxy of schemes and we better just keep quiet and pay no attention to it!

This is a provocative question. We have to realize, however, that outside of our own solar system the probable planet with any life on it is no closer than 10 light years away. This means that if we use radio communications to signal to them or receive one from them, the round trip communications time would be 20 light years. Therefore, if they're capable of doing this we have to assume they're as intelligent as we are, if not more so. I think this points up one of the very subtle, but basic, purposes of all this scientific and space exploration in which we're engaged. Subtle because we don't talk about it too much and basic because it answers a question that man has long been thinking of and asking. What is the origin of life? How has it started? What is life? How do you define it? What is the origin of the species? We might find, for example, that Venus is in the carnivorous period relative to our period. We might find they're in the same stage that we were in a billion years ago and life hasn't gotten started. We'd like to find out just what the sterile planet is like and what the conditions are like which contribute to the beginning of life. This would begin to answer our questions as to how life began here on earth. I think this is the basic reason for a lot of our space exploration.

Question: Do we have any programs other than ones for sending rockets around the moon and Venus; are we trying to get to any of the other planets?

Dr. Duncan: There's the Ranger program - the hard landing on the moon; the Surveyor for a soft landing on the moon - and Apollo for a manned landing on the moon. There are the Mariner programs with a shot to Venus which will get there December 12. There will be Mariner shots to Mars. There are planned probes to the planets that go beyond. There is the Voyager program, larger, more extensive, still unmanned probes of the planets and interplanetary space. The manned exploration of the planets is still in the planning and speculative stages.

Mr. Tamm: Perhaps this will illustrate one aspect of space law: Supposing Glenn had come down in the territory of Russia. Of course, he'd have had to come through their air space. The Chicago Convention states, as a broad principle, the fact that all air space over a given sovereignty is absolute to its controlling. In other words, you have no right of transgression of that atmosphere air space. If we did have such a landing, it would be the same as an aircraft coming down into Soviet territory and we would have our problems. I don't think they would have any right to take a spacecraft that comes down in the high seas because that would be like taking one of our vessels that is going along on the sea.

Dr. Duncan: I know of no case in which a job would be given to an organization which did not have demonstrated capability in this area. Certainly, you don't have to have all of the capability when you get a particular job

if, for instance, you have the technical capability in the concept and have demonstrated a capability on corresponding type programs.

Dr. Duncan to Col. Hull: What do you look for - capability first? Does the organization get the job first?

Col. Hull: Any contractor who makes a proposal to the government must not only have a method of accomplishing an objective, he must have a limited amount of manpower with which to start to do the job. He must also present what his gross rate in manpower will be - how many he expects to do the job. In many instances, it is required that he show where he expects to get these people. I think one of the strongest things that we look for in a company is the management structure. If an organization cannot manage a large group of people efficiently then the job will probably be done very poorly - so, how a company has managed a program previously is many times looked at much more closely than the technical talent available to them at the present time.